Thunderstorm and Severe Thunderstorm Probability in Montana

by

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When do thunderstorms and severe weather occur in Montana? A study was conducted to find out where, and when they occur. With a modernization of the National Weather Service on-going during the 1990s, offices across the United States were consolidated with all having nearly equal functions and capabilities. In the process, the states were divided based upon geography, radar coverage and political boundaries. The responsibility for forecasting and warning in each division was given to a National Weather Service office nearly centrally located in this area.

These large geographic areas are called county warning areas (CWA). In Montana there are four CWAs, with four offices. Glasgow handles the northeast and Billings has the southeast, south central, and Sheridan County, Wyoming. The Great Falls CWA covers an area from the Canadian border, to Idaho, roughly from the continental divide eastward to a Havre - Lewistown - Bozeman line. Missoula has responsibility for west of the divide and three counties in the Idaho panhandle.

Probability of thunderstorms

Thunderstorm probabilities for each of the CWAs were determined by collecting long-term thunderstorm occurrences for select points in each CWA. The Great Falls CWA included the mean of Great Falls (65 years of record), Helena (62 years), Cut Bank and Lewistown (14 years), Bozeman (17 years), Havre (25 years), and Dillon (3 years). The Billings CWA included Billings (63 years), Sheridan WY (62 years), Miles City (14 years), and Baker (2 years). Glasgow's mean included Glasgow (43 years) and Wolf Point (15 years). Finally, the means for Missoula's CWA included Missoula (58 years), Kalispell (52 years), and Butte (17 years). This study included data through the year 2002.

The mean number of thunderstorms for each CWA was determined by summing the number of reported thunderstorms at each location in the CWA, then dividing by the number of locations. The resultant figure was the average for each CWA. For the

probability of thunderstorms, the mean was simply divided by the number of days in each month (Figure 1).

The probability of thunderstorms rises as the weather seasonally warms. Statewide, the greatest probability of thunderstorms on any given day in a month is greatest during the months of June, July and August. The likelihood of thunderstorms is from 20 to 29% during these months. There have been rare thunderstorms in the cooler months, with winter-time thunderstorms mainly reported west of the divide and in a narrow zone immediately east of the continental divide. Wintertime thunderstorms are exceedingly rare over the eastern plains.

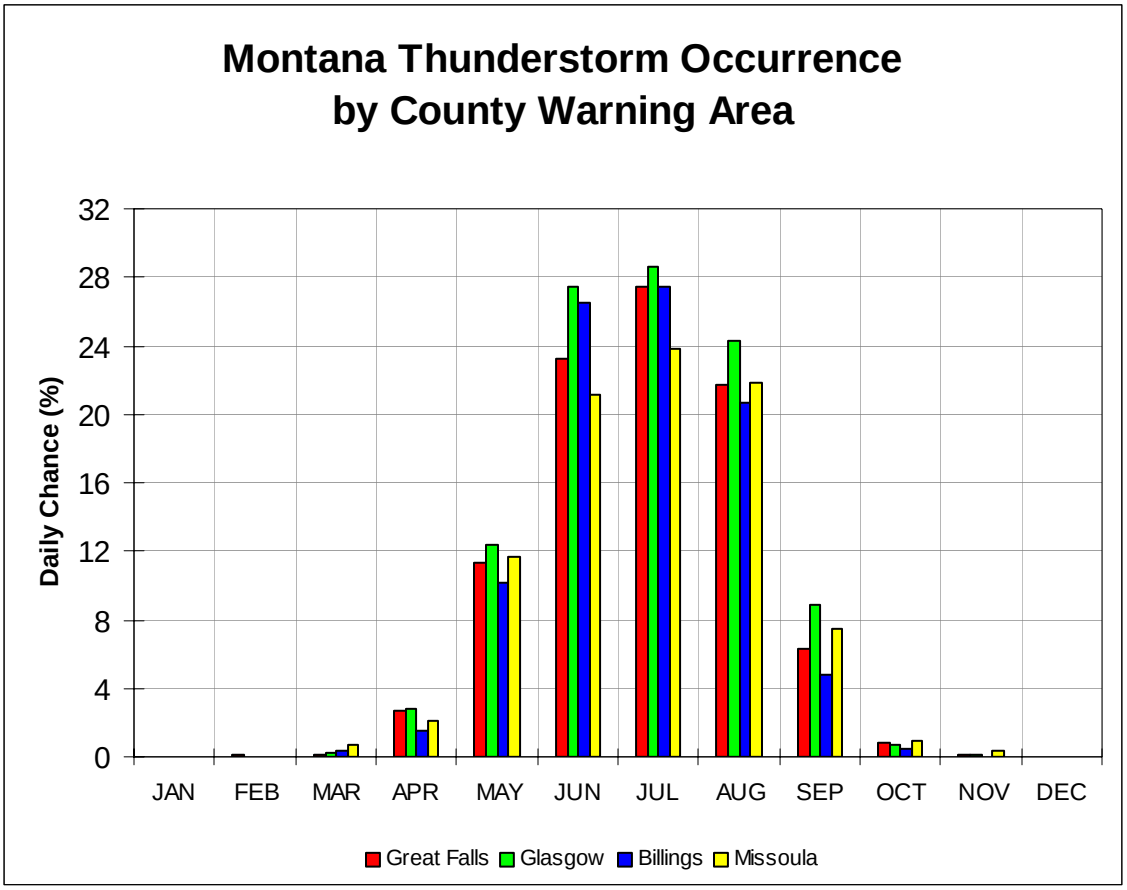

Figure 1. Daily chance of thunderstorms in Montana CWAs. Source: Local Climatological Data. Through 12/31/2005.

Probability of Severe Thunderstorms

The Storm Data publications were reviewed from 1980 through 2002 for Montana, and from 1982 through 2002 for areas outside Montana. The areas included Sheridan county, Wyoming, and that portion of Missoula's CWA in Idaho. All severe weather reports (hail equal to or greater than 3/4 inch, thunderstorm wind gusts equal to or greater than 58

miles per hour, and tornados) were collected for the listed time-frames. After dividing the reports by CWA, they were logged by hour of the day, and by month.

A day was considered one severe weather day whether it had one or 50 reports of severe conditions. After summing up the number of severe weather days for each month, this number was divided by the number of days in the month from 1980 through 2002. The resultant number was taken as the probability of a severe thunderstorm in the month, or sub-period. For example, five reports for April, divided by 630 (21 years times 30 days) results in about 1% probability. This is the probability that severe weather will be reported at any location in the CWA on any given day during the month (Figure 2).

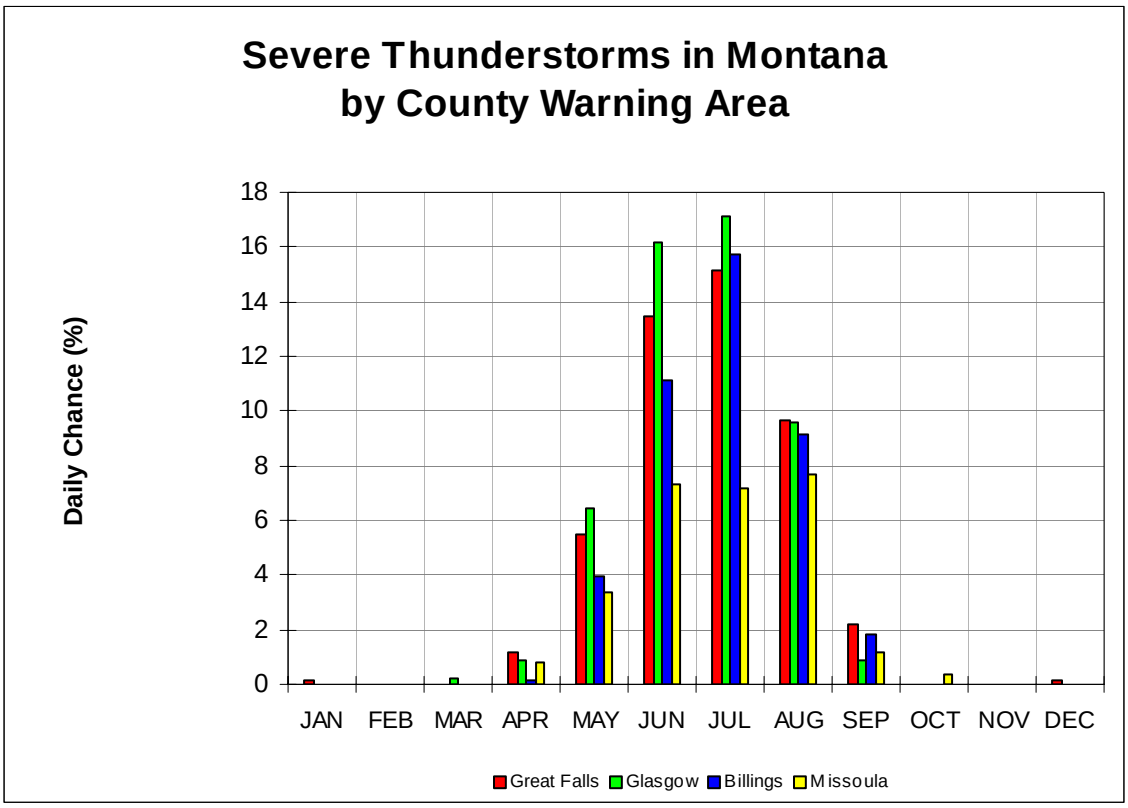

Figure 2. Daily chance of severe thunderstorms in Montana CWAs. Source: Storm Data 1980-2005. Through 12/31/2005.

To further highlight when severe weather occurred, by time of year, another graph was created. This graph illustrates when the peak in severe weather occurs, grouped into 10 day periods (Figure 3). The marker on the graph for each CWA is centered on the mid point of the 10 day period. For example, July 1 would include the period from June 26 through July 5. Once again, this chart shows the peak in severe weather occurring as the

seasonal cycle warms. The peak in severe weather over Montana appears to be from June 15 through August 5, with a secondary peak from August 16 - 25.

These are probabilities that a severe report will be received from any point in the CWA during the listed 10 day periods. This chart shows a little higher probabilities than are indicated on the monthly chart (Figure 2). Great Falls is shown as having the highest probability of severe thunderstorms from July 6 - 15, at 19.8%. This is somewhat higher than the month of July probability of 14.9%.

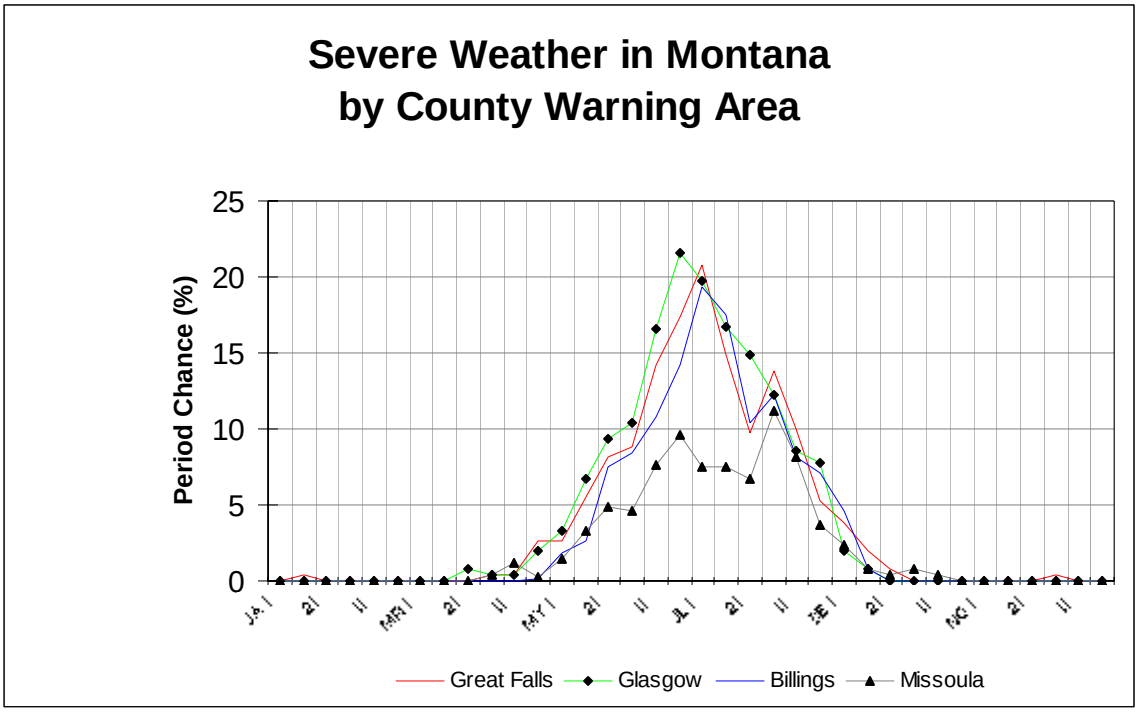

Figure 3. Chance of Severe Weather occurrence by 10-day period in Montana CWAs. Source: Storm Data 1980-2005. Through 12/31/2005.

In Figure 3, these are 10 day mean probabilities with the marker centered on the mid point of the 10 day string. For example, May 10 would indicate the average probability of severe weather from May 6-15.

A look at tornado occurrence is presented in the following plot. It shows the occurrence of tornados in each Montana County Warning Area from 1976 through 2002.

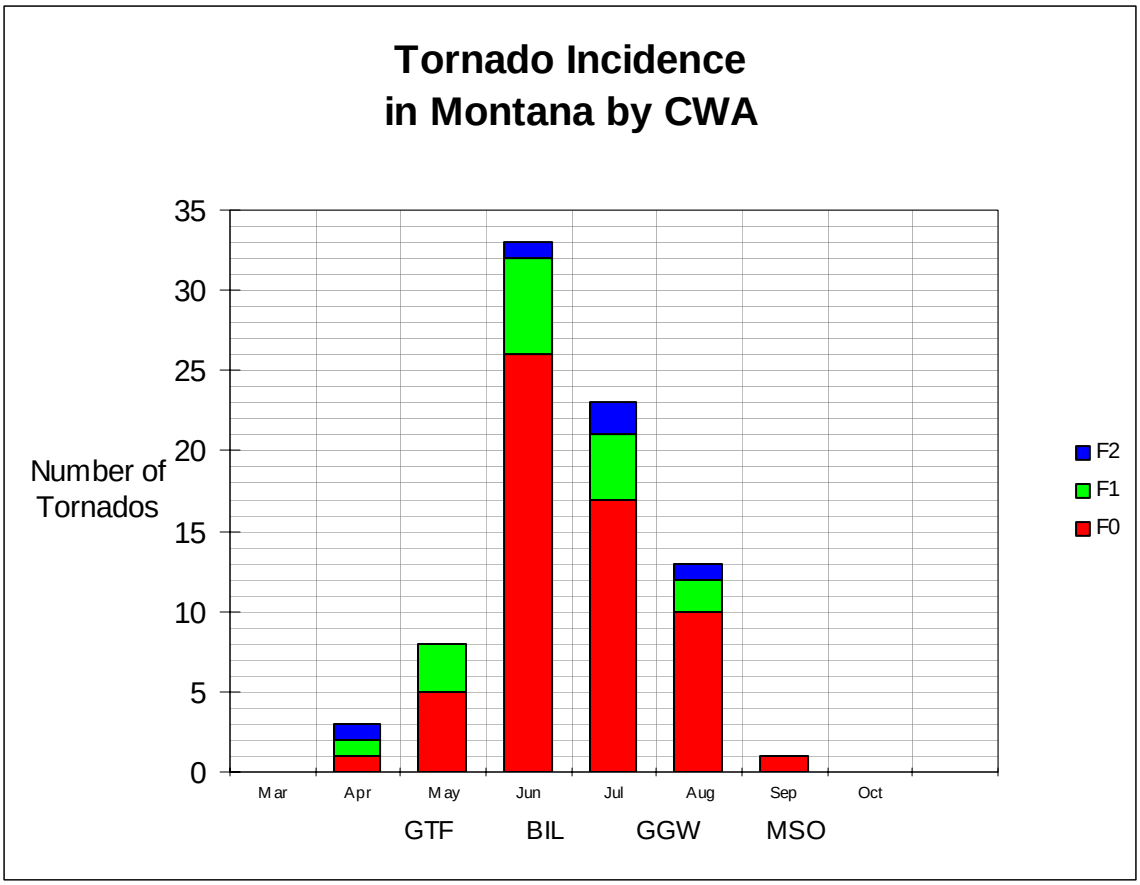

Figure 4. Tornado Incidence in Montana by CWA. Red is F0 tornados, Green: F1 and Blue F2 tornados. Source: Storm Data 1976-2005. Through 12/31/2005.

As Figure 4 shows, tornados occur in all sections of the state. The first tornado reported in the state occurred back in the 1880s. Since then, with a greater population density, the sighting of tornados has increased over the years. The following graph shows the numbers of tornado sightings by year. It also shows the 10-year average number of tornados over a 10-year period, and a 10-year running mean of annual tornado sightings. The year with the greatest number of tornado sightings was 1992 with 29 sightings. The 10-year mean annual number of tornados in Montana is 9 per year (as of 2005).

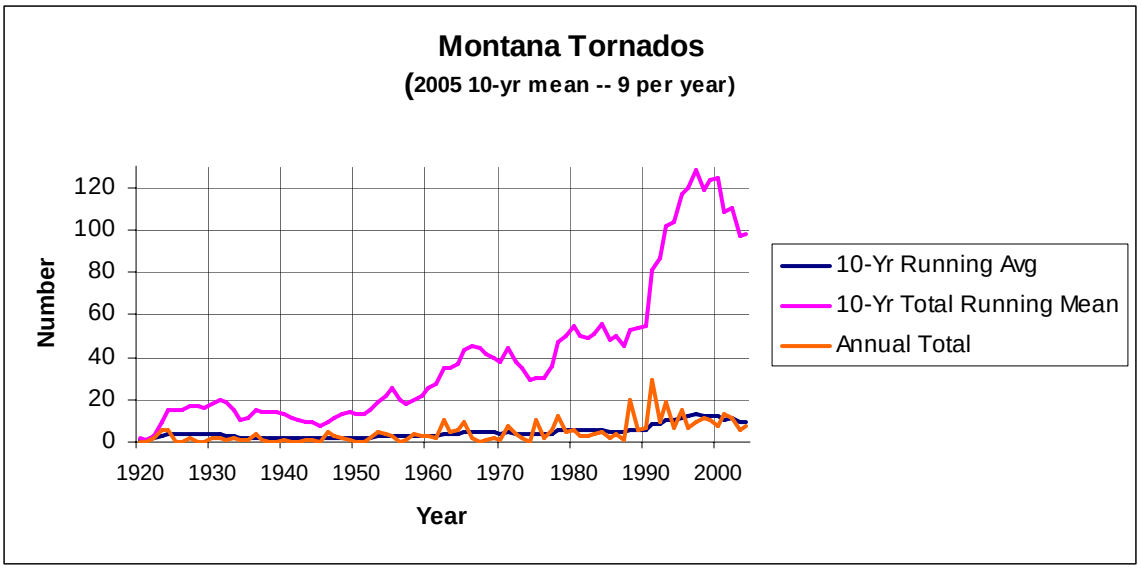

Figure 5. Montana Tornados 1920-2005. Orange: Annual number of tornados. Magenta: 10-year running mean of total number of tornados. Black: 10-year running mean of annual average number of tornados.

Finally, Figure 6 is a graphic showing the total number of tornados in the state, by decade, along with the mean number of tornados by year, by decade. The decade from 1990-99 had 123 tornado sightings in the state. From 2000 through 2005, there have been 55 tornados, giving an annual average of 9.2 during this period.

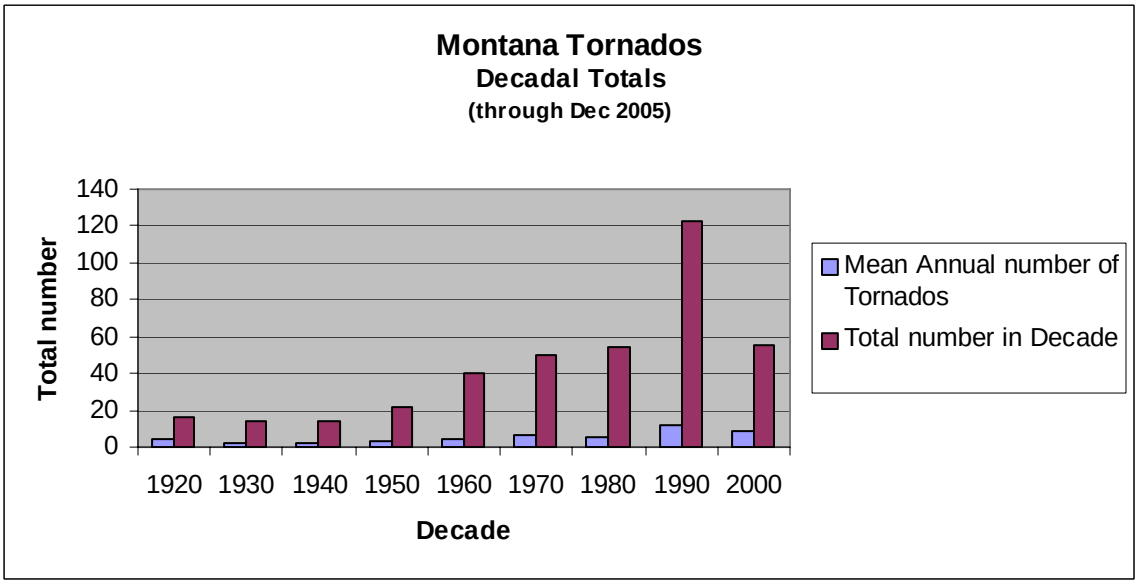

Figure 6. Montana Tornados, Decadal Totals. 1920-2005.